Appsys ProAudio

ADAT Multicore Extender

ADX-32B / ADX-64B-PRO

Device version 2
(black Termination buttons)

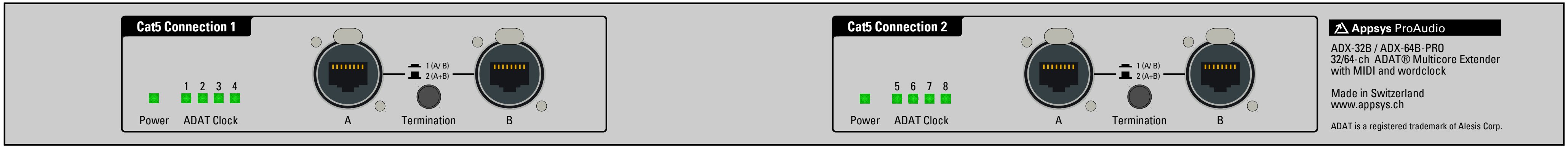
User's Manual

((en))

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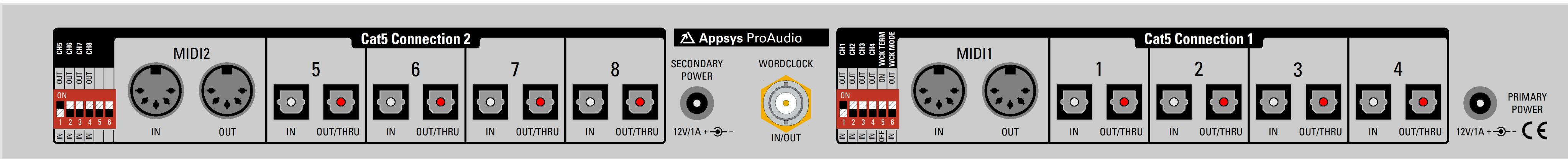
1. DEVICE OVERVIEW

1.1. Front panel



The connectors “Cat5 Connection 2“ are only available in the 64 channel version (ADX-64B-PRO).

1.2. Rear panel

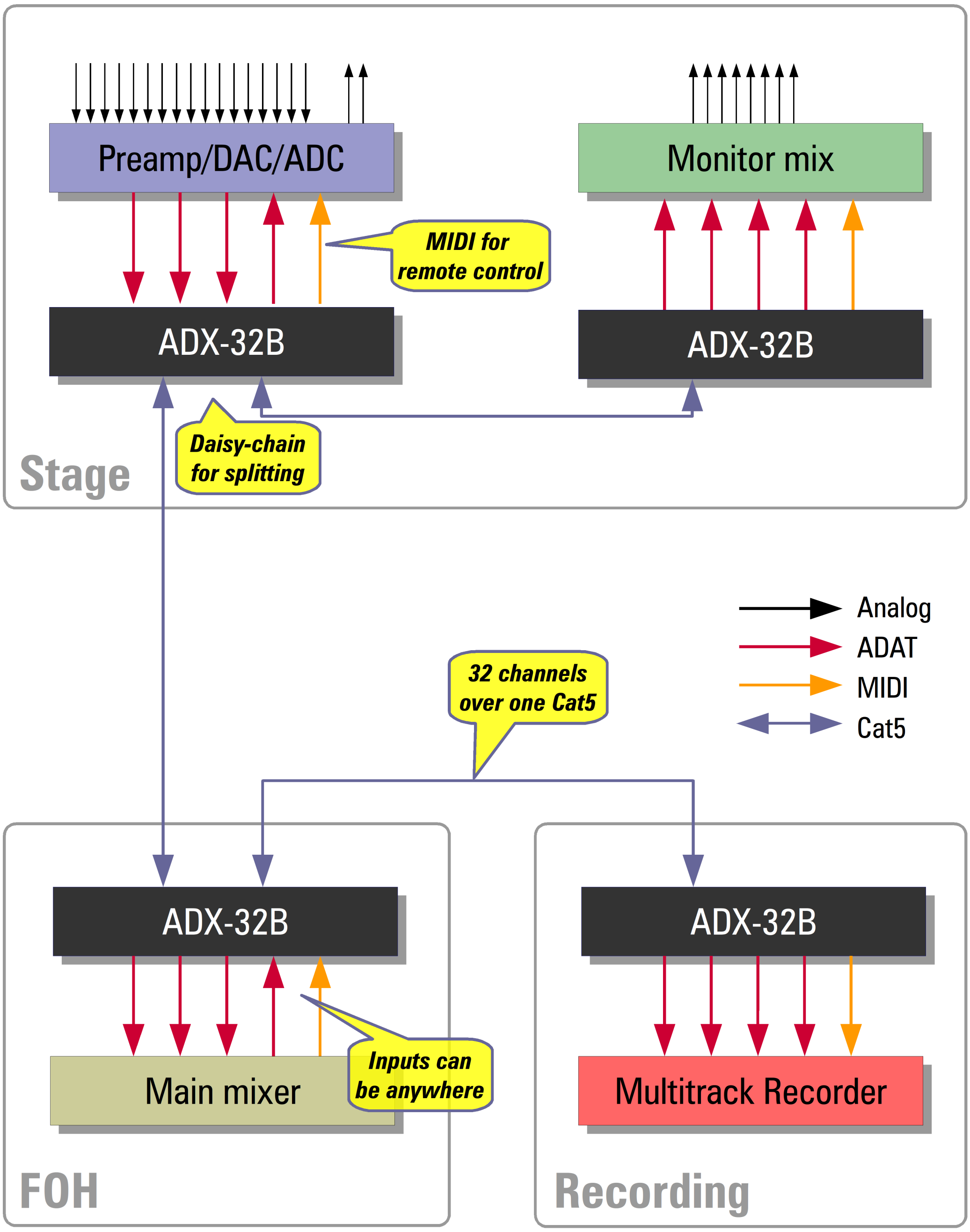


The connectors under “Cat5 Connection 2” are only available in the 64 channel version (ADX-64B-PRO).

2. TYPICAL APPLICATION

2.1. Digital snake (32 channels) with ADX-32B

The diagram below shows a typical application of the ADX devices: One Cat5 cable is used for both the transmission of 24 channels from the stage to the mix console, and 8 channels in the opposite direction. All 32 channels are also fed into a monitor console and into a multi-track recorder. The additional MIDI transmission capability allows remote control of the devices (e.g. the multi-track recorder, or the gain control of the preamp).



3. IMPORTANT SAFETY NOTES

3.1. Cat5 connections

Use the Cat5 cable ONLY between ADX devices.
NEVER connect an ADAT Multicore Extender to any Ethernet networking device (PC, Switch, other network equipment)! The ADX device and/or the networking device may be DAMAGED!

4. INTRODUCTION

4.1. Features

The ADAT Multicore Extender (ADX) allows you to extend and bundle several ADAT connections into standard Cat5 cable, covering up to 100m (330ft) in distance. One Cat5 cable carries up to four ADAT connections (32 channels), one channel of MIDI data, and a wordclock signal.

This makes the ADX a perfect cost-effective digital snake system. It seamlessly integrates with industry standard ADAT equipment and provides a lightweight replacement for bulky and heavy analog multicores.
Thanks to its daisy-chain capability, it can also serve as distribution backbone for monitoring or recording.

The ADX system is superior to an analog snake in many ways:

Improved sound quality and reliability

- No noise, hum, crackling etc. thanks to digital transmission and galvanic isolation
- Very low latency (<1µs)
- Redundant power supply (optional)
- Precision clock recovery for best jitter performance
- Quality product „Made in Switzerland“

Versatile connectivity

- Up to 8 ADAT connections for the transmission 64 channels
- Direction can be set individually for every ADAT connection
- Daisy-chaining possible for easy signal splitting and distribution
- Local loop-back duplicates inputs on the outputs, no splitters needed
- Bi-directional MIDI transmission (two bi-directional channels in the ADX-64B-PRO)
- Wordclock distribution over CAT5
- Wordclock signal extraction from ADAT derives a coaxial wordclock signal from any ADAT data stream. This is especially useful if your master clock has no BNC output

- Upgrade modules available for system extension (ADX-32B to ADX-64B-PRO)

Easy setup and operation

- Lightweight Cat5 cable replaces a heavy analog snake
- Simple, reliable and robust design
- Rugged 19“ aluminum rack case

Seamless integration

- Compatible with all ADAT devices and sample rates up to 24bit/48kHz,
  ADAT S/MUX (Double Speed/DS, up to 24bit/96kHz),
  ADAT S/MUX4 (Quad Speed/QS, up to 24bit/192kHz)
- Other data formats (SPDIF, AC-3, DTS etc.) are supported on request
- Clock cleaner supports even not completely ADAT compatible equipment (e.g. JetPLL devices)

4.2. Available models

	ADX-32B	ADX-64B-PRO
Number of ADAT connections	4	8
Number of MIDI connections	2 (1 per direction)	4 (2 per direction)
Wordclock	Can work as output (extracted from ADAT1's embedded clock), or as Master Clock Input	
Required Cat5 cables	1	2
Redundant power supply	no	yes

4.3. Input and Return channel configuration

The system is designed with maximum flexibility in mind: The direction of data transmission can be selected individually for each ADAT connection. Thus, the ADX-32B can be operated in 32/0, 24/8, 16/16, 8/24 or 0/32 TX/RX channel configuration, and the ADX-64B-PRO can be configured to 64/0, 56/8, 48/16 etc. to 0/64 of TX/RX channels.

4.4. Daisy-chaining

For audio distribution to several places, up to 32 ADAT Multicore Extenders can be daisy-chained together. This feature can be used for complex setups, e.g. multi-room audio distribution or the connection of additional monitoring equipment. Each signal input can be located at an arbitrary ADX device in the chain, and is then distributed to all other ADX devices. This allows very flexible setups for recording and monitoring.

5. IMPORTANT SETUP NOTES

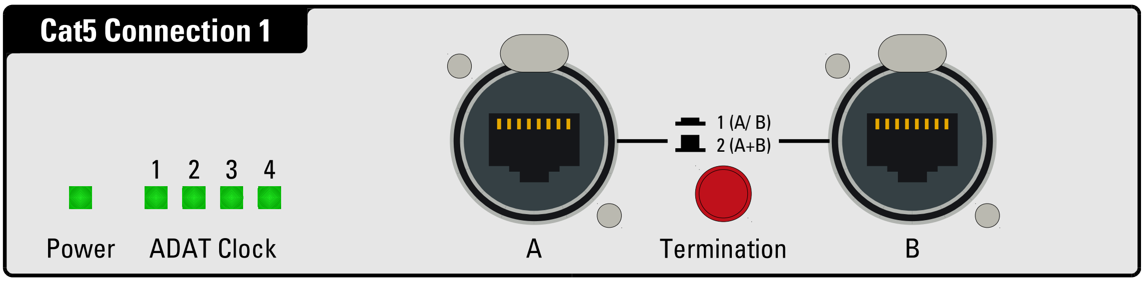
The ADX can correctly receive even very degraded ADAT signals, e.g. caused by long or cheap quality optical cables, and is able to recover them perfectly („Clock cleaning“ function). For this to work, a Master Clock signal is required which can be either derived from the ADAT stream on ADAT1 (default) or alternatively from an external wordclock source, connected to the BNC jack.

To use ADAT1 as master clock, make sure DIP switch 6 is set to „OUT“. The clock signal will be derived from ADAT1 and also output on the BNC jack.
To use the BNC jack as master clock input, set DIP switch 6 to „IN“. The ADX now requires a master clock input on the BNC jack.

Note: When the „ADAT Clock“ LEDs are blinking, an ADAT signal has been detected but the master clock is missing.

6. FRONT PANEL

6.1. Cat5 Connection 1



Connection 1 for Cat5 cable (ADAT signals 1-4 and MIDI1 data)

- LEDs 1-4 show the current status of the channels 1-4.

OFF	No signal
ON	ADAT signal detected, valid master clock detected, „clock cleaning“ active
Blinking	ADAT signal detected but no valid master clock . No transmission possible! Please make sure that you have • an ADAT signal coming from the clock master on ADAT1, and DIP switch 6 is set to „OUT“ or • an external wordclock signal connected to the WORDCLOCK jack, and DIP switch 6 is set to „IN“

- Jacks “A” and “B” are electrically paralleled.

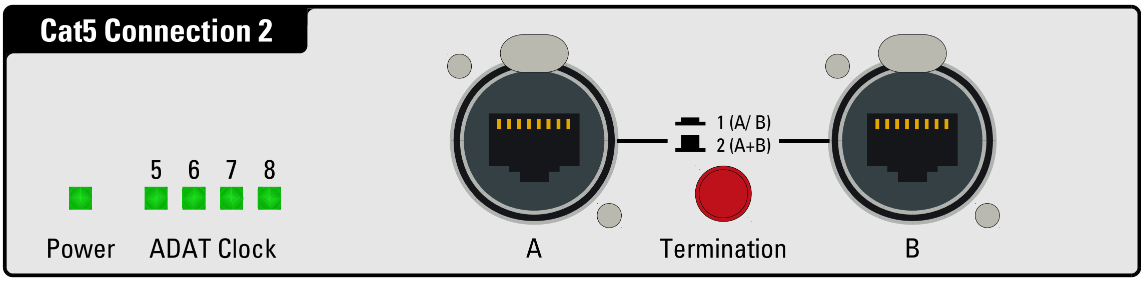
- The switch "Termination" must be set depending on the the number of cables plugged in: 1 cable = "ON", 2 cables = "OFF". If you use only two devices (point-to-point connection), the termination must always remain switched on.

Wrong termination settings are, depending on the cable length, not always immediately noticeable and the system appears to function properly. But reliability and immunity to noise is significantly decreased, because either signals reflections occur with missing termination or transmitters get overloaded by too many terminations.

If you're using the system in the same setup all time, you may use scotch tape to fix the push button (or remove the push button cap) in order to prevent unwanted operation.

NOTE: Redundant connections (the connection of two units with two cables over A and B at the same time) are **not** supported! This would lead to signal loops causing undefined current flow.

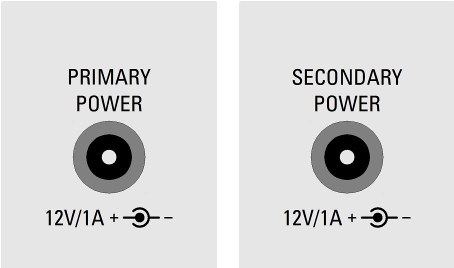
6.2. Cat5 Connection 2 (ADX-64B-PRO only)



Connection 2 for Cat5 cable (ADAT signals 5-8 and MIDI2 data)

7. REAR PANEL

7.1. POWER Connections

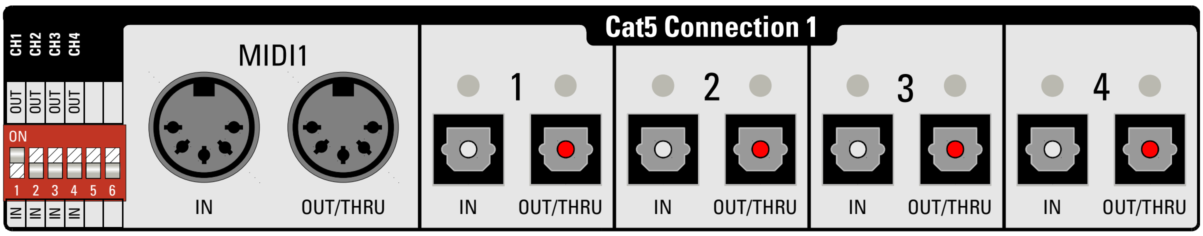


Connect the supplied DC adapter(s) here.

- The input „SECONDARY POWER“ is only available in the ADX-64B-PRO and allows you to connect a second (redundant) power supply. Both power supplies work independently, and if one of them fails, the other one takes over. This is particularly useful to make the system immune to failure of a single AC phase in 3-phase supplies. The status of the respective supply is shown on the corresponding front panel “Power” LEDs.

- Use only the supplied DC adapter, or a replacement with the indicated voltage, power, polarity and matching connector (see 12. Specifications). The input has a reverse-polarity protection.

7.2. ADAT 1-4



The transmission direction (TX or RX) must be set using the DIP switches 1-4:

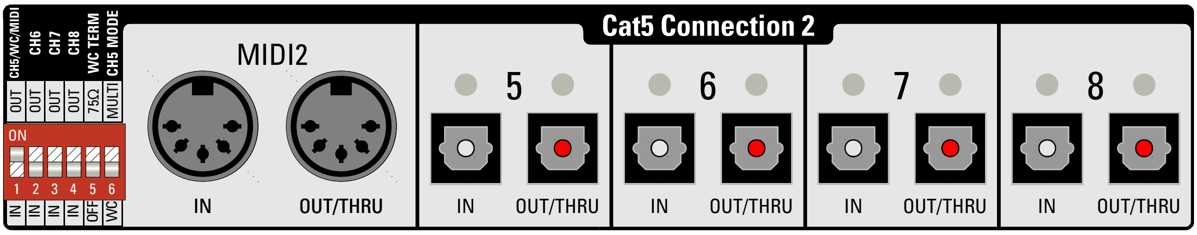
- **Input** (DIP switch in lower position = OFF): The ADAT connection is configured as input, the received data is sent to the Cat5 cable.

  The input signal is passed-through to the output alongside ("local loop-back"). You can use this output to connect additional monitors or as wordclock source, as shown in 7.2. Synchronization over ADAT.

  If you're using a daisy-chain of ADX devices, make sure that there is exactly one “Input” per ADAT connection in the chain.

- **Output** (DIP switch in upper position = ON): The ADAT connection is configured as output. Data received from the Cat5 cable is output on the “Output” jack. The input jack is inactive.

7.3. ADAT 5-8 (ADX-64B-PRO only)



The transmission direction (TX or RX) for channels 5-8 must be set using the DIP switches 1-4 (see 6.2. ADAT 1-4).

7.4. MIDI1

The ADX can transmit MIDI in a bi-directional way. Because this feature makes use of the „User Bit“ in the ADAT data stream, a valid ADAT signal in the same transmission direction is required. The ADX picks the first ADAT connection which is set to „IN“ for the MIDI TX, and the first ADAT connection which is set to „OUT“ for the MIDI RX:

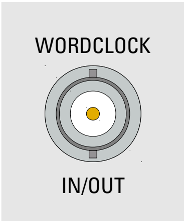
- If you want to send MIDI data, at least one of the ADAT connections 1-4 must be set to „IN“ and must carry a valid signal
- If you want to receive MIDI data, at least one of the ADAT connections 1-4 must be set to „OUT“ and must carry a valid signal

7.5. MIDI2

Works like MIDI1, except that ADAT5 is used for data transmission.

- If you want to send MIDI data, at least one of the ADAT connections 5-8 must be set to „IN“ and must carry a valid signal
- If you want to receive MIDI data, at least one of the ADAT connections 5-8 must be set to „OUT“ and must carry a valid signal

7.6.Wordclock



The wordclock jack can be operated in two modes, which can be set with DIP switch #6:

- **OUTPUT:** In this mode, the ADX derives its clock signal from the signal on ADAT1. The extracted wordclock signal is additionally available on the WORDCLOCK jack and can be used to clock other devices (ADCs etc.). Please note: DIP switch 5 (WCK Term) should be set to „OFF“ in this operating mode.

  This mode is recommended in most cases. The only thing you need to care about is that the signal on ADAT1 comes directly from your clock master (e.g. the mixing console).

- **INPUT**: In this mode, the ADX expects a clock signal on the WORDCLOCK jack (which is configured as an input). If the clock is missing, the device does not work (LEDs are blinking if ADAT signals are present but no wordclock).

  This mode is recommended if you are using an external master clock. The ADX on the other side of the Cat5 should be set to wordclock output – the master clock will be transmitted over the Cat5 cable and is available on the BNC jack on the remote ADX.

  Note: WCK Termination (DIP switch #5) should be set to „ON“ if you are connecting an coax cable directly to the ADX. When the ADX is connected via a „T“-shaped adapter and the wordclock cable continues to other devices, WCK Termination should be switched off.

Wordclock termination on other devices

- The wordclock master device (the sender) should be located at the end of the BNC cable chain. If there is any termination switch or jumper, it must be “OFF”.

- All devices in the middle of the cable (which are usually connected by “T”-shaped adapters must have their wordclock termination set to “OFF”.

- The **last** device on the chain (where the cable ends) must have the wordclock termination set to “ON”. This can either be done by setting the appropriate switch or jumper on the device, or, if there is no such thing, by installing a “T”-shaped BNC adapter with a 75 ohms resistor attached. Different manufacturers handle word-clock termination differently, please refer to the manual of the respective device for instructions.

8. DEVICE SYNCHRONIZATION

8.1. General concept

For all signal sources and sinks within a digital audio system, it is required to share a common clock. This ensures that data processing on all channels and on all devices happens at exactly the same rate. Otherwise, the individual clocks would drift apart with time, causing the number of samples generated by one device to differ from the number of samples expected by another – a common symptom for this are to drop-outs, crackles and dropped samples.
To prevent this, one device (usually the mix console) is the clock master. All other devices operate in slave mode, following the master's clock signal when generating samples.

Two ways exist to distribute the clock signal from the master to the slaves:

8.2. Synchronization over ADAT

Any ADAT signal can be used for wordclock synchronization as it carries an embedded clock signal. The master clock device outputs ADAT streams with the master clock timing embedded, and slaves can extract the embedded wordclock from the stream. Please refer to your equipment's manual how to set the synchronization to ADAT. If this type of synchronization is used, no additional cabling is required.

Use the "local loop-back" feature to break out additional ADAT signal outputs which can be used as wordclock source. An example configuration using ADAT sync is shown under 10.1. Digital 24/8 multicore.

8.3. Synchronization over coaxial cable

For larger installations, it is often not convenient to use ADAT for synchronization because of its limitations: ADAT connections cannot be split easily, and length restrictions may prevent you from reaching all devices. In such cases, it is better to transmit the wordclock signal over a dedicated, separate connection. For this purpose, a coaxial cable with BNC plugs is commonly used, combining long reach (>100m) with the possibility to distribute the signal to several slave devices using “T”-shaped connectors.

The wordclock feature eliminates the need for running an extra coaxial cable beside the Cat5. Refer to 10.2. Digital 48/16 multicore with monitoring and recording splits for an example.

9. CABLE RECOMMENDATIONS

9.1. Cat5 cable

Cable Quality
Cat5 cabling is commonly used, cheap, with a huge selection on the market to choose from. With the ADX devices, **any cable that meets Cat5 or higher (e.g. Cat5e, Cat6, Cat7) can be used**. A higher “Cat” number cable has no *electrical* advantage over a basic Cat5 type, because the parameters where the higher graded one performs better are only important for much faster systems, like Ethernet applications.
However, if *mechanical* robustness is an important issue, it is recommended to use a ruggedized Cat5 cable with Neutrik® EtherCon® connectors. Ready-to-use cable drums are available from several vendors; good value for money, stage-proven Cat5 cable drums are made by Adam Hall, for example.

Technology
Cat5 cable consists of four twisted pairs, each made up of two single wires. One pair can carry one ADAT stream (8 channels), yielding a total transmission capacity of 32 channels. The transmission method used on the media is called “differential pair signaling” or “balanced transmission”. This means that each signal is transmitted over a wire pair, where one wire carries the inverted signal of the other one. In contrast to unbalanced (ground-referenced) systems, differential signaling provides very good noise immunity, because coupled noise affects both wires the same way and can be canceled out at the receiver's side by subtracting one wire's signal from the other. Additionally, EMI is greatly reduced because the electric and magnetic fields surrounding the two wires cancel each other out.

The technology used in the ADAT Multicore Extender (RS-485) has been used for a long time, e.g. for lighting applications (DMX) or harsh industrial environments (Profibus). The commonly used AES/EBU standard works in a similar manner, but is, due to its relatively low data rate, only able to transmit two audio channels over one pair. State-of-the-art technology is used in the ADAT Multicore Extenders to ensure reliable operation at the higher data rates required by the ADAT protocol.

9.2. Toslink (Lightpipe) cable

Toslink cables are generally not critical if you don't exceed their length limit of 5m (16ft). Quality cables usually provide a tighter fit (=better latching) in the jack than cheaper ones, and may perform better on longer runs. Plastic Optical Fiber (“POF“) cables are cheap and immune to electromagnetic interference, but are limited in reach. Larger runs cause problems as the light pulses are attenuated too much, leading to data errors which usually result in drop-outs or crackles. Furthermore, POFs are also very sensitive to breaks and sharp bends which may be a problem in harsh stage environments.

10. DIGITAL SIGNAL QUALITY

10.1. Latency

Latency has – in contrast to traditional analog systems – always been a topic in digital audio technology. High latency can lead to unwanted effects, such as phasing, hall, echo etc. and can seriously affect audio performance.

By design, other digital snake solutions (e.g. Ethernet based systems) have a relatively high propagation delay, because audio data has to be sampled, buffered, converted, transmitted, buffered and then finally converted back to the original format. These delays can easily add up to several tens or hundreds of milliseconds which makes them unusable for many applications, especially for monitoring purposes.

One design goal of the ADX was to create a system with one of the lowest latencies on the market. This is achieved by performing no conversion at all, and only minimal buffering with clock alignment.

These measures allow an excellent overall latency of less then 1μs, which is not noticeable (sound waves travel only 0.3mm during this delay)!

10.2. Jitter

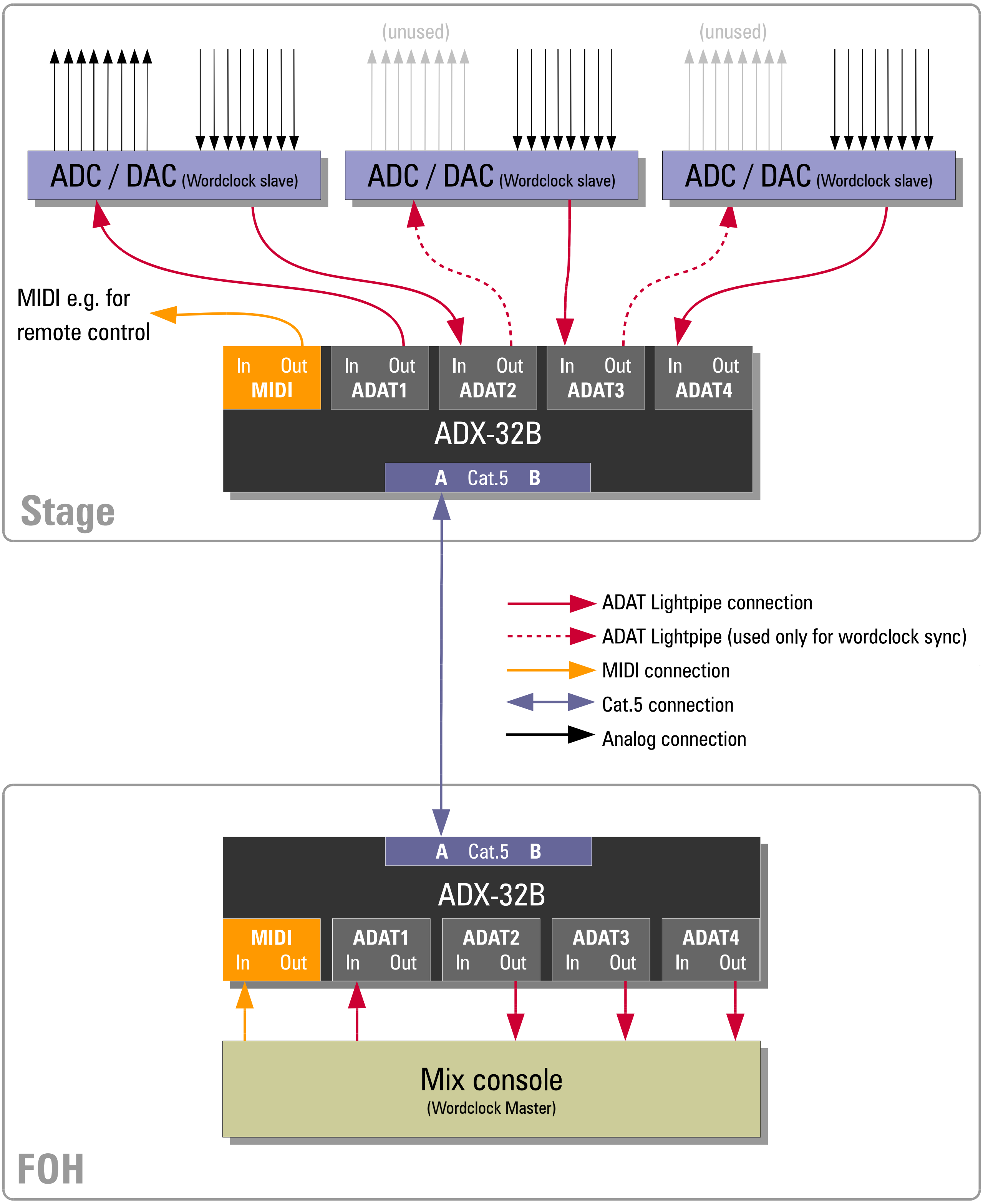
In any digital audio transmission, the clock signal picks up a certain amount of jitter (clock phase noise). Jitter can affect audio performance (SNR) if a jittered clock is directly used for D/A or A/D conversion, and can even lead to drop-outs or data errors if the jitter values is so high that it is impossible to determine the correct value of a bit.

For proper operation of ADAT connections, jitter is also an important issue because the duration of the “start of frame” mark is used to calculate the sample point of the subsequent bits in the data stream. In contrast to bi-phase-mark encoding used by SPDIF and AES/EBU, the ADAT signal uses NRZ encoding which allows the double data rate, but makes it more difficult to extract the proper bit timing.

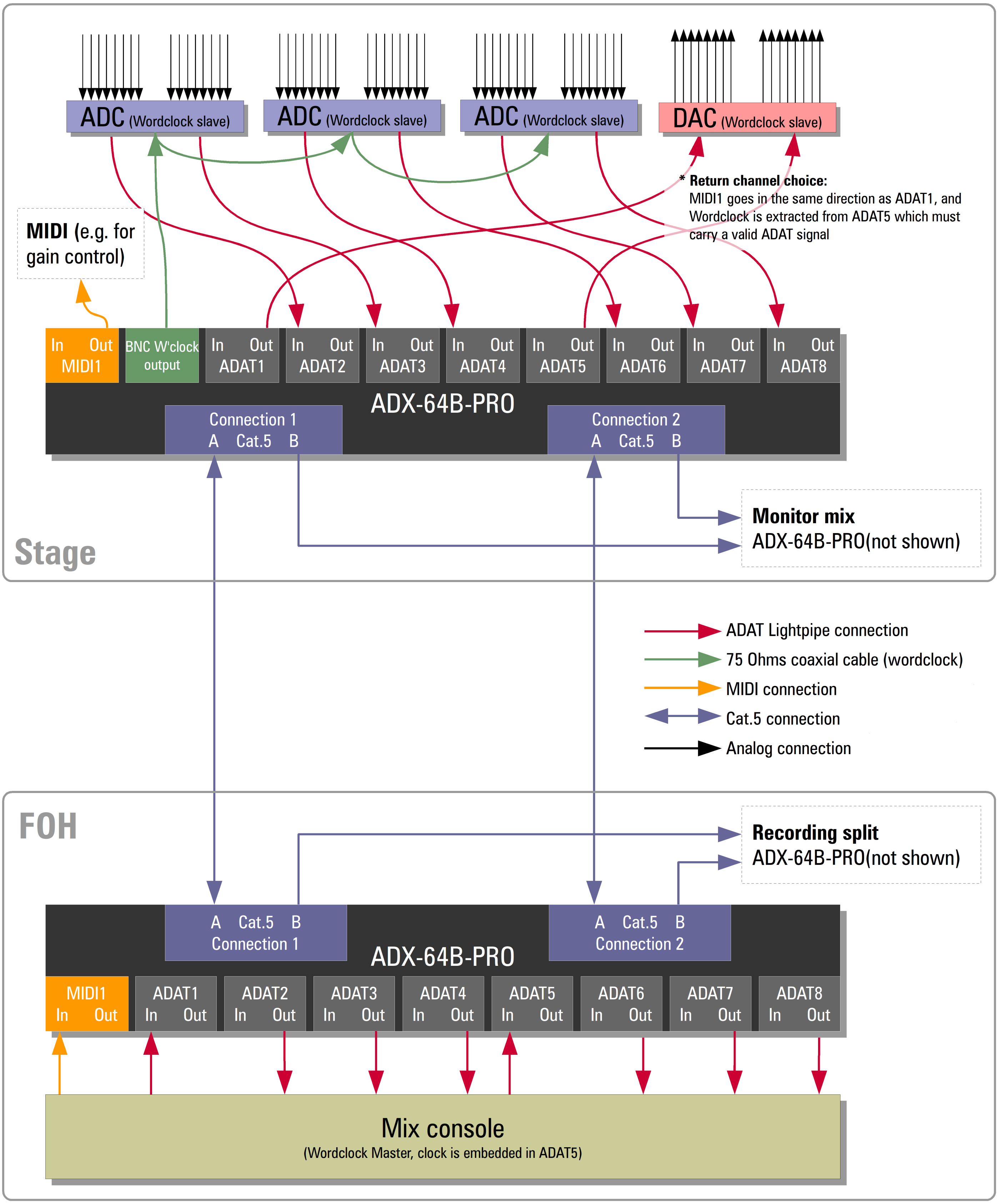
To cope with jitter, each ADAT signal is fed to a PLL circuitry which cleans the jitter by recovering proper timing characteristics before the signal is output. **The overall jitter of an ADAT signal transmitted over 100m (330ft) Cat5 cable is only ±1.5ns typ.** and is in the same range of the jitter usually introduced by a standard short fiber optic connection. This feature allows seamless integration even with “picky” equipment (like the Presonus Digimax FS microphone preamp, or Yamaha consoles at 48kHz) which refuses proper clock tracking when there is a higher amount of jitter in the signal.

11. EXAMPLE APPLICATIONS

11.1. Digital 24/8 multicore



11.2. Digital 48/16 multicore with monitoring and recording splits



12. SETTINGS OVERVIEW

Switch location	Label	Function	ON (upper position)	OFF (lower position)
Front panel "Cat5 Conn.1"	**Termination**	Cat5 cable termination	One cable connected to "Cat5 Connection 1"	Two cables connected to "Cat5 Connection 1"
Front panel "Cat5 Conn. 2"	**Termination**	Cat5 cable termination	One cable connected to "Cat5 Connection 2"	Two cables connected to "Cat5 Connection 2"
Rear panel "Cat5 Conn.1"	**1**	ADAT1 direction	ADAT1 is output	ADAT1 is inputs duplicated on "OUT/THRU" jack
	2	ADAT2 direction	ADAT2 is output	ADAT2 is input duplicated on "OUT/THRU" jack
	3	ADAT3 direction	ADAT3 is output	ADAT3 is input duplicated on "OUT/THRU" jack
	4	ADAT4 direction	ADAT4 is output	ADAT4 is input duplicated on "OUT/THRU" jack
	5	Wordclock termination	75 Ohms termination active	Termination inactive
	6	Wordclock mode	Output (extracted from ADAT1). ADAT1 must come from the clock master device!	Input. A master clock must be connected to the WORDCLOCK jack.
Rear panel "Cat5 Conn.2" (ADX-64B-PRO)	**1**	ADAT5 direction	ADAT5 is output	ADAT5 is input duplicated on "OUT/THRU" jack
	2	ADAT6 direction	ADAT6 is output	ADAT6 is input duplicated on "OUT/THRU" jack
	3	ADAT7 direction	ADAT7 is output	ADAT7 is input duplicated on "OUT/THRU" jack
	4	ADAT8 direction	ADAT8 is output	ADAT8 is input duplicated on "OUT/THRU" jack
	5	unused		
	6	unused		

13. SPECIFICATIONS

<table>
<tr><th>Parameter</th><th>ADX-32B</th><th>ADX-64B-PRO</th></tr>
<tr><td>Number of ADAT connections
(audio channels)</td><td>4 (32)</td><td>8 (64)</td></tr>
<tr><td>Number of MIDI connections</td><td>2 (=1 bi-directional)</td><td>4 (=2 bi-directional)</td></tr>
<tr><td>Wordclock input/output</td><td colspan="2">Standard BNC connector
Configured as input:
“H”-level: ≥ 1.6 V
“L”-level: ≤ 1.1V
Configured as output:
“H”-level: ≥ 3.1V an 75 Ω
“L”-level: ≤ 0.1V
Short-circuit protected
Termination (75 Ω) built-in, switchable</td></tr>
<tr><td>Pin assignment Cat5 cable
Jacks A+B are paralleled</td><td colspan="2">
<table>
<tr><th>Pin</th><th>Standard wire color (TIA/EIA 568B)</th><th>Cat5 Connection 1</th><th>Cat5 Connection 2 (ADX-64B-PRO only)</th></tr>
<tr><td>1</td><td>orange/white</td><td>ADAT1+</td><td>ADAT 5+</td></tr>
<tr><td>2</td><td>orange</td><td>ADAT1–</td><td>ADAT 5–</td></tr>
<tr><td>3</td><td>green/white</td><td>ADAT2+</td><td>ADAT 6+</td></tr>
<tr><td>4</td><td>blue</td><td>ADAT3 +</td><td>ADAT 7 +</td></tr>
<tr><td>5</td><td>blue/white</td><td>ADAT3 –</td><td>ADAT 7–</td></tr>
<tr><td>6</td><td>green</td><td>ADAT2 –</td><td>ADAT 6–</td></tr>
<tr><td>7</td><td>brown/white</td><td>ADAT4+</td><td>ADAT 8+</td></tr>
<tr><td>8</td><td>brown</td><td>ADAT4–</td><td>ADAT 8–</td></tr>
</table>
All pins are short-circuit protected.
ESD protection: ±15 kV according to IEC 61000-4-2</td></tr>
<tr><td>Cat5 cable connectors</td><td colspan="2">Neutrik EtherCon®, compatible with standard RJ45 connectors</td></tr>
<tr><td>ADAT Input/Output connectors</td><td colspan="2">Optical connector F05 type (TOSLINK ®)</td></tr>
<tr><td>MIDI connectors</td><td colspan="2">Standard 5-pin DIN</td></tr>
<tr><td>Transmission media</td><td colspan="2">Twisted-Pair cable (100 ohms) according to Cat5 specification or higher
(e.g. Cat5e, Cat6, Cat7).</td></tr>
<tr><td>Maximum distance (end-to-end distance of daisy-chain)</td><td colspan="2">330ft (100m)
For longer distances, additional ADX-64B-PRO units can be used as repeaters</td></tr>
<tr><td>Maximum # of ADX per daisy chain</td><td colspan="2">32</td></tr>
<tr><td>Supported data formats</td><td colspan="2">■ ADAT Lightpipe ® up to 48kHz 24bit
■ ADAT Lightpipe ® 96kHz 24bit (S/MUX, DS)
(when using 2 optical connections per 8 channels)
■ ADAT Lightpipe ® 192kHz 24bit (S/MUX4, QS)
(when using 4 optical connections per 8 channels)</td></tr>
<tr><td>ADAT Latency</td><td colspan="2"><1µs (entire system)
<1µs in „local loop-back” mode</td></tr>
<tr><td>Jitter (measured at output)</td><td colspan="2">330ft (100m) Cat5 cable: <0.5ns typ.</td></tr>
<tr><td>Power supply</td><td colspan="2">12V DC 1.0 A, Polarity: +–⊙–– (center positive),
Plug type: ID=2.5mm, OD=Ø 5.5mm, Length=9mm
Supplied DC adapters are isolated from earth</td></tr>
<tr><td>Shielding / Grounding</td><td colspan="2">Case is floating (unearthed)
Cat5 shield is connected internally to power supply GND
Wordclock jack outer conductor to power supply GND
*) Power supply GND is unearthed</td></tr>
</table>

Temperature range	Operation: 32°F...140°F (0°C…+60°C) Storage: 14°F...140°F (-10°C…+60°C)
Dimensions	19“ rack 1HE 60 mm in depth
Weight	900 grams approx.

14. APPENDIX

14.1.Warranty

We offer a full two (2) year warranty from the date of purchase. Within this period, we repair or exchange your device free of charge in case of any defect.*

If you experience any problems, please contact us first. We try hard to solve your problem as soon as possible - even after the warranty period.

* Not covered by the warranty are any damages resulting out of improper use, willful damage, normal wear-out (especially of the connectors) or connection with incompatible devices (including, but not limited to, Ethernet equipment and third-party power supplies).

14.2. Contact

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14.3. Recycling

According to EU directive 2002/96/EU, electronic devices with a crossed-out dustbin may not be disposed into normal domestic waste.
Please return the products back for environment-friendly recycling, we'll refund you the shipping fees.

14.4. About this document

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EtherCon® is a registered Trademark of Neutrik AG

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